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(54) IMAGE PROCESSOR AND IMAGE PROCESSING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image processor by which the contrast and sharpness of an entire image are enhanced more than heretofore.
SOLUTION: An edge of which the change of the pixel value is sharp is kept as it is and input image data S1 is amplified except this edge to emphasize and display the part other than the edge, and thus the contrast and sharpness of the entire image are

enhanced mote than heretofore.

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]An image processing device provided with an image processing means which amplifies portions other than the edge concerned while change of a pixel value had saved steep edge among inputted image data characterized by comprising the following.
A smoothing means which a described image processing means smooths the above-mentioned inputted image data, with the above-mentioned edge of the above-mentioned inputted image data saved, and generates smoothed image data.
After subtracting the above-mentioned smoothed image data from the above-mentioned inputted image data and amplifying the subtraction result concerned, A nonlinear transformation means which it consists of an image enhancement means to add the above-mentioned smoothed image data and to generate output image data, and also the above-mentioned smoothing means performs nonlinear transformation to the above-mentioned inputted image data of each, and generates nonlinear image data.
A nonlinear filtering means to give a nonlinear digital filter and to generate nonlinear smoothed image data to the above-mentioned nonlinear image data.
A nonlinear inverse transformation means to perform inverse transformation of the above-mentioned nonlinear transformation means to the above-mentioned nonlinear smoothed image data, and to generate smoothed image data.

[Claim 2]The image processing device according to claim 1, wherein the above-mentioned nonlinear filtering means changes a degree of smoothing accommodative based on a difference value of a central pixel and its neighborhood picture element.
[Claim 3]The image processing device according to claim 1, wherein the

above-mentioned nonlinear transformation means changes a value of the above-mentioned inputted image data so that it may not be dependent on strength of illumination light at the time of a size of the above-mentioned difference value picturizing described image data.

[Claim 4]The image processing device according to claim 1, wherein the above-mentioned nonlinear filtering means consists of several nonlinear filters in which sizes connected in series differ.

[Claim 5]The image processing device according to claim 1 by which the above-mentioned nonlinear filtering means' consisting of several nonlinear filters in which sizes connected in series differ, and being located in the latter part as a small filter.

[Claim 6]In an image processing method which performs image processing which amplifies portions other than the edge concerned while change of a pixel value had saved steep edge among inputted image data, Smooth the above-mentioned inputted image data, with the above-mentioned edge of the above-mentioned inputted image data saved, and smoothed image data is generated, After subtracting the above-mentioned smoothed image data from the above-mentioned inputted image data and amplifying the subtraction result concerned, It consists of a step which adds the above-mentioned smoothed image data and generates output image data, Remove a noise component among the above-mentioned inputted image data, and noise rejection image data is generated, After subtracting the above-mentioned smoothed image data from the above-mentioned noise rejection image data and amplifying the subtraction result concerned, A step which adds the above-mentioned smoothed image data and generates output image data is included, Perform nonlinear transformation to the above-mentioned inputted image data of each, and nonlinear image data is generated, An image processing method containing a step which gives a nonlinear digital filter to the above-mentioned nonlinear image data, generates nonlinear smoothed image data, performs inverse transformation of the above-mentioned nonlinear transformation means to the above-mentioned nonlinear smoothed image data, and generates smoothed image data.

[Claim 7]The image processing method according to claim 6 changing a degree of smoothing accommodative based on a difference value of a central pixel and its neighborhood picture element, and generating the above-mentioned nonlinear smoothed image data.

[Claim 8]The image processing method according to claim 6 changing a value of the above-mentioned inputted image data so that it may not be dependent on strength of illumination light at the time of a size of the above-mentioned difference value picturizing described image data.

[Claim 9]The image processing method according to claim 6 giving several nonlinear filters in which sizes differ to the above-mentioned nonlinear image data in in-series,

and generating the above-mentioned nonlinear smoothed image data.

[Claim 10]The image processing method according to claim 6 giving several nonlinear filters in which sizes differ to the above-mentioned nonlinear image data in in-series sequentially from a thing with the large size, and generating the above-mentioned nonlinear smoothed image data.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is applied to a video camera, concerning an image processing device and a method for the same, and is preferred.

[0002]

[Description of the Prior Art]Conventionally as a method of raising the contrast (difference of light and darkness) and sharpness (bordering precision) of a picture which were picturized by the solid state image pickup device (CCD:Charge Coupled Device) in a video camera, The high-frequency component emphasis method of emphasizing the contrast of the high-frequency component in the contrast stretching method by gray scale conversion or a picture is considered.

[0003]The function which has predetermined input/output relation for the pixel level to each pixel of a picture as the contrast stretching method. The tone curve adjustment changed by (this is hereafter called a level conversion function), The method called histogram IKORAIZESHON to which a level conversion function is changed accommodative according to the frequency distribution of a pixel level is proposed, and as the high-frequency component emphasis method, Edge is extracted from a picture and the method called the unsharp mask which performs what is called edge enhancement that emphasizes the extracted edge concerned is proposed.

[0004]

[Problem(s) to be Solved by the Invention]by the way, the thing which a problem which cannot raise contrast among all the dynamic ranges (difference of a maximum level and a minimum level) of a picture only in some luminosity regions is in the contrast stretching method -- in addition, In tone curve adjustment, in the maximum bright section and the maximum dark space of a picture, there was a problem that contrast fell conversely, in near [with little / in histogram IKORAIZESHON / frequency distribution] a luminosity region. Furthermore, only the contrast of the high-frequency component of a picture was emphasized in the high-frequency component emphasis method, near the edge of a picture was emphasized unnaturally by this, and there was a problem which cannot avoid that image quality deteriorates.

[0005]This invention was made in consideration of the above point, and tends to propose an image processing device which may raise the contrast and sharpness of the whole picture much more as compared with the former, and a method for the same.

[0006]

[Means for Solving the Problem]Portions other than edge can be emphasized and displayed by amplifying portions other than the edge concerned, while change of a pixel value had saved steep edge among inputted image data in this invention, in order to solve this technical problem.

[0007]

[Embodiment of the Invention]About a drawing, the 1 embodiment of this invention is explained in full detail below.

[0008](1) In the 1st embodiment drawing 1, 1 shows the composition of the video camera of a 1st embodiment as a whole, The inputted image data S1 picturized by the solid state image pickup device (CCD:Charge Coupled Device) 2 is inputted into the delay circuit 4 and the nonlinear smoothing machine 5 of the image processing circuit 3. The inputted image data S1 is a two-dimensional digital image, and expresses the pixel value corresponding to the position (i, j) on a picture as x (i, j) here.

[0009]As opposed to outputting as it is, without the nonlinear smoothing machine's 5 extracting an edge component with a steep change of a pixel value out of this inputted image data S1, and smoothing to the edge component concerned, By smoothing to small-size width ingredients other than an edge component, the inputted image data S1 concerned is smoothed, with the edge component of the inputted image data S1 saved.

[0010]Specifically, the nonlinear smoothing machine 5 inputs the inputted image data S1 into the linearity low pass filter 10, as shown in drawing 2. The linearity low pass filter 10 attenuates the signal level of a very high frequency component among the inputted image data S1, and sends out the image data S2 obtained as a result to the look-up table 11. Thus, when the linearity low pass filter 10 attenuates the signal level of a very high frequency component among the inputted image data S1, When the latter epsilon filter 12 performs data smoothing, it has prevented remaining on a picture as a punctiform noise, without smoothing a high frequency component with large amplitude enough. Incidentally, this linearity low pass filter 10 is constituted by a picture being horizontal and applying perpendicularly, respectively in a one-dimensional linearity low pass filter, or is constituted by the two-dimensional linearity low pass filter.

[0011]The look-up table 11 performs gray scale conversion like logarithmic transformation as opposed to the image data S2, and sends out the image data S3 obtained as a result to the epsilon filter 12A. By the way, although the latter epsilon filter 12 performs accommodative data smoothing according to the amplitude of image data, generally the size of the amplitude of image data becomes large in proportion to the strength of the illumination light which is irradiating with the candidate for an image pick-up. Then, when the look-up table 11 performs data smoothing in the latter epsilon

filter 12 by log transforming to the image data S2 beforehand, it makes it possible not to be based on lighting conditions but to acquire the same smooth effect. Controlling a smooth effect according to a pixel value, such as making the emphasis degree by latter image enhancement processing increase etc., also makes the look-up table 11 possible with this by making a smooth effect high, for example in the dark field and the bright field of a picture.

[0012]The epsilon filter 12A which is a nonlinear smoothing filter, It is a digital filter effective when smoothing the pixel value concerned, without spoiling a steep change of a pixel value, The image data S3 concerned is smoothed with the edge of the image data S3 supplied from the look-up table 11 saved, and smoothed-image-data S4A obtained as a result is sent out to the epsilon filter 12B. In data smoothing in this epsilon filter 12A, in the case of 2N+1 tap, the pixel for filtering is a following formula at one dimension.

[0013]

[Equation 1]

$$y_n = \sum_{k=-N}^{N} a_k \cdot w_{n-k} \qquad \cdots\cdots (1)$$

$$\sum_{k=-N}^{N} a_k = 1$$

$$|x_n - x_{n-k}| \leq \varepsilon \quad \text{のとき} \quad w_{n-k} = x_{n-k}$$

$$|x_n - x_{n-k}| > \varepsilon \quad \text{のとき} \quad w_{n-k} = x_n$$

[0014]It is expressed be alike.

[0015]That is, the epsilon filter 12A compares absolute value |xn -xn-k | of the difference of the pixel value xn of the central pixel pn of filtering, and pixel value xn-k of pixel pn-k with the predetermined threshold epsilon. As a result, when absolute value |xn -xn-k | judges that it is smaller than the predetermined threshold epsilon, the epsilon filter 12A. A picture is uniformly smoothed focusing on the central pixel pn by substituting pixel value xn-k for wn-k, and performing the same processing as the usual linearity low pass filter which made ak each tap coefficient.

[0016]On the other hand, when absolute value |xn -xn-k | judges that it is larger than the predetermined threshold epsilon, the epsilon filter 12A, After substituting the pixel value xn for wn-k and transposing pixel value xn-k of pixel pn-k to the pixel value xn of the central pixel pn, by performing low pass filter processing focusing on the central pixel pn concerned, pixel value xn-k is disregarded and it smooths only with a pixel value near the pixel value xn.

[0017]As the epsilon filter 12A is shown, for example in drawing 3, when exceeding the threshold epsilon predetermined in an absolute value of a difference of a pixel value before and behind steep edge, By transposing the pixel value xm of the pixel pm to the pixel value xn of the central pixel pn, and performing low pass filter processing, when performing low pass filter processing focusing on the central pixel pn, To smoothing near the pixel value xn, when performing low pass filter processing focusing on the pixel pm, it smooths near the pixel value xm.

[0018]At this time, the epsilon filter 12A saves a steep change of edge as it is by outputting the pixel value x of the pixel p of the edge part concerned almost as it is by the pixel p of an edge part in which the pixel p with the near pixel value x does not exist within limits which perform filtering. Incidentally, the epsilon filter 12A may be constituted by a case where one-dimensional epsilon filter is constituted by a picture being horizontal and applying perpendicularly, respectively, and two-dimensional epsilon filter, like the linearity low pass filter 10.

[0019]By the way, the epsilon filters 12B-12N which become with the same composition as the epsilon filter 12A concerned are connected to the latter part of the epsilon filter 12A one by one, and it is made as [raise / a flattening effect] by performing data smoothing one by one to smoothed-image-data S4A. Thus, smoothed-image-data S4N by which ingredients other than edge were fully smoothed is obtained, and the latter look-up table 13 is supplied.

[0020]A pixel for filtering shows composition of the epsilon filter 12A in the case of seven taps by one dimension, and drawing 4 comprises the register sequences 20A-20F, the selectors 21A-21F, the amplifiers 23A-23G, and the adding machine 24 here. As shown in drawing 5, the register sequence 20A is constituted by connecting in series the registers 22A-22E which hold a pixel value for 1 pixel, respectively, and is constituted like [sequences / 20B-20F / register] the register sequence 20A.

[0021]The selector 21A inputs into the adding machine 30 and the selector 31 the pixel value xn of the central pixel pn shown in drawing 3, as shown in drawing 6, and it inputs the pixel value xm of the pixel pm into the adding machine 30 and the selector 31. The adding machine 30 takes a difference of the pixel value xn and the pixel value xm, and sends out the result to the absolute value converter 32. The absolute value converter 32 asks for absolute value |xn -xm | of a difference of the pixel value xn and the pixel value xm, and sends this out to the size comparator 33.

[0022]The size comparator 33 compares this absolute value |xn -xm | with the predetermined threshold epsilon, and sends out that comparison result to the selector 31. To absolute value |xn -xm | choosing the pixel value xm, and sending out to the latter amplifier 23A, in being smaller than the predetermined threshold epsilon, when larger than the predetermined threshold epsilon, absolute value |xn -xm | chooses the pixel value xn, and sends out the selector 31 to the latter amplifier 23A.

[0023]The selectors 21B-21F are constituted like the selector 21A, respectively, and send out the pixel value x of the selected pixel p to the amplifiers 23B and 23C of the latter part corresponding, respectively, and 23E-23G. The amplifier 23D is made as [supply / from the register sequence 20C / the pixel value xn of the central pixel pn].

[0024]The amplifiers 23A-23G are for carrying out the multiplication of the ******** tap coefficient ak to the pixel value x inputted, after sending out the result of an operation to the adding machine 24, respectively and adding in the adding machine 24 concerned, set this to smoothed-image-data S4A, and send it out to the epsilon filter

12B.

[0025]Although it is desirable to generate a picture with as much as possible little change in portions other than edge by this data smoothing, in the epsilon filter 12A, it is necessary to use a very big filter for that purpose. However, when a filter to be used is enlarged, if the multiplication of the tap coefficient ak is carried out to all the pixels, the latter selectors 21A-21F and the number of the amplifiers 23A-23G must also be made to increase, and circuit structure will increase. Then, by the register 22 for several pixels constituting each register sequence 20 from this embodiment, respectively, and being made to give only 1 pixel of the head of each register sequence 20 to data processing after this, epsilon filter which covers a wide range spatially is realized without making latter circuit structure increase. For example, when the number of the registers 22 is set to 2 to epsilon filter of seven taps, it becomes possible to constitute a filter with a size [as shown in drawing 13 according to equivalent circuit structure] of 13 pixels x 13 pixels. however, while the filter which has a significant coefficient only at intervals of several pixels in this way can expect a big flattening effect, it has the tendency for a side lobe to become large generally, and an unnecessary high frequency component remains and burns it of smoothed image data -- it becomes. Comparison of a frequency response of a filter which changed the number of the registers 22 and constituted it is shown in drawing 14. A horizontal axis is the frequency which normalized a Nyquist rate as 0.5, and a vertical axis expresses a frequency response of a filter. Filter A, Filter B, and Filter C correspond, respectively, when the number of the registers 22 is 1, 2, and 3, and each actual filter factor is as being shown in drawing 15. Drawing 14 also shows that a side lobe is increasing, so that there are many registers 22. So, at this embodiment, in order to avoid this problem, control of a flattening effect and a side lobe is reconciled by connecting in series two or more epsilon filters 12A-12N which have the same composition except for the number of the register sequence 20A - the registers 22 in 20F. That is, while acquiring a big flattening effect with epsilon filter with many registers 22, epsilon filter with few registers 22 removes an unnecessary high frequency component which passed a side lobe of other filters. Here, since epsilon filter has the character to pass a high frequency component in an edge periphery, when epsilon filter with few registers 22 is used previously, a frequency component which passed the main lobe may not decrease it enough with latter epsilon filter by an edge periphery. Therefore, in order to acquire a good flattening effect, it is desirable to apply sequentially from what has many number of the registers 22.

[0026]The look-up table 13 performs inverse transformation of logarithmic transformation which the look-up table 11 performed to smoothed-image-data S4N supplied from the epsilon filter 12N, and sends out the smoothed image data S10 obtained as a result to the linearity low pass filter 35. By dulling slightly edge of the smoothed image data S10 smoothed with edge saved, the linearity low pass filter 35 generates the smoothed image data S11, and sends this out to the adding machines 40

and 41 (drawing 1). Thereby, smoothness of a picture near the edge can be held in latter image enhancement processing.

[0027]It returns to drawing 1, and the delay circuit 4 carries out specified quantity delay of the inputted image data S1 picturized by CCD2, and is sent out to the adding machine 40 by making this into the delay image data S15. The adding machine 40 constitutes an image enhancement means with the adding machine 41 and the multiplier 42, subtracts each pixel value s of the smoothed image data S11 (i, j) from each pixel value x of the delay image data S15 (i, j), and sends out the difference image data S16 obtained as a result to the multiplier 42.

[0028]Respectively the multiplier 42 carries out the multiplication of the gain factor g (i, j) to each pixel value (x(i, j)-s (i, j)) of the difference image data S16, amplifies it to it, and sends out the difference image data S17 obtained as a result to the adding machine 41. A uniform value or a value set to each pixel (i, j) of every is used for gain factor g (i, j) to the full screen here.

[0029]As opposed to each pixel value g(i, j) x (x(i, j)-s (i, j)) of the difference image data S17 in which the adding machine 41 is supplied from the multiplier 42, Each pixel value s of the smoothed image data S11 which is an offset part subtracted by the adding machine 40 (i, j) is added, and the output image data S18 obtained as a result is sent out to the camera signal processing circuit 45. The camera signal processing circuit 45 performs predetermined data processing to the output image data S18, and the output image data S19 obtained as a result is sent out to VTR(Video Tape Recorder) 46, and it records it.

[0030]Each pixel value y of the output image data S18 outputted from the image processing circuit 3 (i, j) is a following formula. [0031]

[Equation 2]

$$y(i,j) = g(i,j) \times (x(i,j) - s(i,j)) + s(i,j) \qquad \cdots\cdots (2)$$

[0032]It is expressed be alike. In this (2) type, transpose gain factor g (i, j) to the full screen at uniform gain factor G, and. The following formula showing the contrast stretching method according [this (2) type] to the conventional tone curve adjustment when each pixel value s of the smoothed image data S11 (i, j) is transposed to the median of the dynamic range of the inputted image data S1, or the average value C of a total pixel value [0033]

[Equation 3]

$$y(i,j) = G \times (x(i,j) - C) + C \qquad \cdots\cdots (3)$$

[0034]** -- it is expressed like.

[0035]In above-mentioned (2) types, transpose gain factor g (i, j) to the full screen at uniform gain factor G, and. The following formula showing the high-frequency component emphasis method according [this (2) type] to the conventional unsharp

mask when each pixel value s of the smoothed image data S11 (i, j) is transposed to each pixel value f (i, j) of the image data which performed linearity low pass filter processing to each pixel value x of the inputted image data S1 (i, j) [0036]

[Equation 4]

$$y(i,j) = G \times (x(i,j) - f(i,j)) + f(i,j) \quad \cdots\cdots (4)$$

[0037]** -- it is expressed like.

[0038]Thus, the conventional contrast stretching method, Are the method of performing image enhancement processing independently for every pixel of a picture, and the conventional high-frequency component emphasis method, The method by this embodiment to being the method of performing image enhancement processing based on a relative level difference with the peripheral pixel which exists around a central pixel, The conventional contrast stretching method and the high-frequency component emphasis method are unified using a nonlinear smoothing filter, and more nearly high-definition image enhancement processing is enabled.

[0039]In the above composition, the image processing circuit 3 smooths the inputted image data S1 concerned, saving an edge component of the inputted image data S1 with the nonlinear smoothing machine 5, and generates the smoothed image data S11. And after the image processing circuit's 3 considering this smoothed image data S11 as an offset part, subtracting it from the delay image data S15 which is a source image and carrying out the multiplication of the gain factor to that subtraction result, the smoothed image data S11 which is an offset part is added.

[0040]Therefore, a signal level of small-size width ingredients other than the edge component concerned can be emphasized, saving an edge component among the inputted image data S1, Contrast of the whole picture can be raised, maintaining a dynamic range of a picture in this way, and sharpness of a picture can be raised also near edge. Thereby, photography of a distant view as for which it grew dim, and photography in fog can also photo a clear picture from which a dynamic range and contrast were secured, and, as for the video camera 1, can perform high-definition image enhancement processing.

[0041]After according to the above composition smoothing the inputted image data S1 concerned, with an edge component of the inputted image data S1 saved and generating the smoothed image data S11, By adding the smoothed image data S11, after considering the smoothed image data S11 concerned as an offset part, subtracting from the inputted image data S1 and carrying out the multiplication of the gain factor to the subtraction result, A signal level of small-size width ingredients other than the edge component concerned can be emphasized saving an edge component among the inputted image data S1, and as compared with the former, contrast and sharpness of the whole picture may be raised much more, maintaining a dynamic range of a picture in this way.

[0042](2) Drawing 7 which attaches and shows identical codes to a corresponding point with the 2nd embodiment drawing 1 shows the video camera 50 of a 2nd embodiment, and is constituted like the video camera 1 of a 1st embodiment except for composition of the image processing circuit 51.

[0043]In the case of this embodiment, the nonlinear smoothing machine 5 sends out the smoothed image data S11 to the adding machine 40 and the delay circuit 52. The adding machine 40 subtracts the smoothed image data S11 from the delay image data S15, and sends out the difference image data S16 obtained as a result to the noise rejection filter 53.

[0044]The noise rejection filter 53 reduces a noise component of the difference image data S16, and sends out the difference image data S30 obtained as a result to the multiplier 42. The noise rejection filter 53 has input-output behavioral characteristics as shown, for example in drawing 8, and performs gray scale conversion called coring which reduces a noise component with not outputting a small-size width ingredient of a range shown by a figure Nakaya seal. As a result, a S/N ratio (signal to noise ratio) of image data which a noise component is amplified in the latter multiplier 42, and is outputted from the image processing circuit 51 is prevented from deteriorating.

[0045]Respectively the multiplier 42 carries out the multiplication of the gain factor to each pixel value of the difference image data S30, amplifies it to it, and sends out the difference image data S31 obtained as a result to the adding machine 41. The delay circuit 52 carries out specified quantity delay of the smoothed image data S11, and sends it out to the adding machine 41 by making this into the delay smoothed image data S32.

[0046]To each pixel value of the difference image data S31 supplied from the multiplier 42, the adding machine 41 adds each pixel value of the smoothed image data S32 which is an offset part, and sends out the output image data S33 obtained as a result to the look-up table 54. The look-up table 54 performs gray scale conversion which compresses the neighborhood near the black of white as shown in drawing 9 as opposed to the output image data S33, and sends out the output image data S34 obtained as a result to the camera signal processing circuit 45. Even if it is a case where a pixel value exceeds a die NAMIKU range by black or a white side by summing processing of the adding machine 41 by this, clipping distortion by which gradation is crushed near white near the black is prevented from occurring.

[0047]In the above composition, the image processing circuit 51 smooths the inputted image data S1 concerned, saving an edge component of the inputted image data S1 with the nonlinear smoothing machine 5, and generates the smoothed image data S11. And after the image processing circuit's 51 considering this smoothed image data S11 as an offset part, subtracting it from the delay image data S15 which is a source image and carrying out the multiplication of the gain factor to that subtraction result, the smoothed image data S11 which is an offset part is added.

[0048]Therefore, a signal level of small-size width ingredients other than the edge component concerned can be emphasized, saving an edge component among the inputted image data S1, Contrast of the whole picture can be raised, maintaining a dynamic range of a picture in this way, and sharpness of a picture can be raised also near edge.

[0049]After according to the above composition smoothing the inputted image data S1 concerned, with an edge component of the inputted image data S1 saved and generating the smoothed image data S11, By adding the smoothed image data S11, after considering the smoothed image data S11 concerned as an offset part, subtracting from the inputted image data S1 and carrying out the multiplication of the gain factor to the subtraction result, A signal level of small-size width ingredients other than the edge component concerned can be emphasized saving an edge component among the inputted image data S1, and as compared with the former, contrast and sharpness of the whole picture may be raised much more, maintaining a dynamic range of a picture in this way.

[0050]By reducing a noise component of the difference image data S16 in the noise rejection filter 53, a S/N ratio of the output image data S34 can be prevented from a noise component being amplified in the latter multiplier 42, and deteriorating. By performing gray scale conversion which furthermore compresses the neighborhood near the black of white to the output image data S33 in the look-up table 54, even if it is a case where a pixel value exceeds a die NAMIKU range, generating of clipping distortion can be prevented.

[0051](3) In the 3rd embodiment drawing 10, by CCD61, the video camera 60 of a 3rd embodiment is shown as a whole, and 60 picturizes a color picture, it uses the picturized color picture concerned as the inputted image data S40, and inputs it into the color separation circuit 62. The color separation circuit 62 divides this inputted image data S40 into trichromatic image data of R(red) G(green) B (blue), respectively, Among these, it inputs into the image processing circuit 3A of the image processing portion 63 by using green image data as the green image data S40G, It inputs into the image processing circuit 3B of the image processing portion 63 by using red image data as the red image data S40R, and inputs into image processing circuit 3C of the image processing portion 63 by using blue image data as the blue image data S40B.

[0052]The image processing circuit 3A - 3C become with the same composition as the image processing circuit 3 shown in drawing 1, respectively, It is made as [perform / processing which emphasizes a signal level of small-size width ingredients other than the edge component concerned saving an edge component to the image data S40G inputted, S40R, and S40B /, respectively].

[0053]Namely, after the image processing circuit's 3A smoothing the green image data S40G concerned, with an edge component of the green image data S40G saved and generating smoothing green image data, After subtracting the smoothing green image

data concerned from the green image data S40G as an offset part and carrying out the multiplication of the gain factor to the subtraction result, by adding smoothing green image data, the green output image data S41G is generated, and it sends out to the camera signal processing circuit 64.

[0054]The image processing circuit 3B and 3C like the image processing circuit 3A by performing above-mentioned processing to the red image data S40R and the blue image data S40B, respectively, The red output image data S41R and the blue output image data S41B are generated, and it sends out to the camera signal processing circuit 64, respectively.

[0055]the camera signal processing circuit 64 -- the green output image data S41G, the red output image data S41R, and the blue output image data S41B -- it is alike, respectively, it receives and predetermined data processing is performed, and the output image data S42 obtained as a result is sent out to VTR65, and is recorded.

[0056]In the above composition, the image processing circuit 3A - 3C smooth the image data S40G concerned, S40R, and S40B, respectively, with an edge component of the image data S40G, S40R, and S40B saved, and generate smoothed image data. And after the image processing circuit 3A - 3C consider this smoothed image data as an offset part, subtract it from the image data S40G which is a source image, S40R, and S40B, respectively and carry out the multiplication of the gain factor to that subtraction result, they add smoothed image data which is an offset part, respectively.

[0057]Therefore, a signal level of small-size width ingredients other than the edge component concerned can be emphasized, respectively, saving an edge component among the image data S40G, S40R, and S40B, Contrast of the whole picture can be raised, maintaining a dynamic range of a picture in this way, and sharpness of a picture can be raised also near edge.

[0058]According to the above composition, with an edge component of the image data S40G, S40R, and S40B saved The image data S40G concerned, After smoothing S40R and S40B, respectively and generating smoothed image data, By adding smoothed image data, respectively, after considering the smoothed image data concerned as an offset part, subtracting from the image data S40G, S40R, and S40B, respectively and carrying out the multiplication of the gain factor to the subtraction result, A signal level of small-size width ingredients other than the edge component concerned can be emphasized saving an edge component among the image data S40G, S40R, and S40B, and as compared with the former, contrast and sharpness of the whole picture may be raised much more, maintaining a dynamic range of a picture in this way.

[0059]A color picture picturized by CCD61 is divided into the three primary colors of RGB, By performing image processing which emphasizes a signal level of small-size width ingredients other than the edge component concerned, respectively saving an edge component to the separated image data S40G concerned, S40R, and S40B, respectively, Even if it is a case where a color picture is inputted, as compared with the former,

contrast and sharpness of the whole picture may be raised much more, maintaining a dynamic range of a picture.

[0060](4) Although a case where a noise component was reduced from the difference image data S16 with the noise rejection filter 53 using a technique called coring in other embodiment, in addition 2nd above-mentioned embodiment was described, This invention constitutes a noise rejection filter, smooths only a small-size width ingredient of the difference image data S16, and it may be made to reduce a noise component with the epsilon filter 12A shown not only in this but in drawing 4.

[0061]In a 2nd above-mentioned embodiment, although a case where the noise rejection filter 53 had been arranged in the latter part of the adding machine 40 was described, in short, this invention should be located in the preceding paragraph of the multiplier 42 in the noise rejection filter 53 in addition to this, and may be arranged in the preceding paragraph or the latter part of the delay circuit 4.

[0062]Although a case where the color separation circuit 62 separated the inputted image data S40 into a three-primary-colors signal of RGB was described in a 3rd above-mentioned embodiment, It may be made to divide this invention not only into this but into color-difference-signal B-Y which subtracted the luminance signal Y from color-difference-signal R-Y which subtracted the luminance signal Y from the luminance signal Y and the red signal R, and the blue signal B.

[0063]Although a case where one-dimensional or two-dimensional epsilon filter constituted epsilon filter in the image processing circuit 3A - 3C was described, it may be made for not only this but three-dimensional epsilon filter to constitute this invention in a 3rd above-mentioned embodiment.

[0064]In this case, as shown in drawing 11 which attaches and shows identical codes to a corresponding point with drawing 10, the image processing portion 71 of the video camera 70, The green image data S40G supplied from the color separation circuit 60 is inputted into the image processing circuits 72A-72C, the red image data S40R is inputted into the image processing circuits 72A-72C, and the blue image data S40B is inputted into the image processing circuits 72A-72C.

[0065]The image processing circuits 72A-72C a pixel value of the green image data S40G, for example gn, It is a following formula to instead of in absolute value |xn -xn-k | [in / when a pixel value of rn and the blue image data S40B is set to bn for a pixel value of the red image data S40R / above-mentioned (1) type] of a difference of the pixel value xn and pixel value xn-k. [0066]

[Equation 5]

$$((r_n - r_{n-i})^2 + (g_n - g_{n-j})^2 + (b_n - b_{n-k})^2)^{1/2} \quad \cdots\cdots (5)$$

[0067]each -- the ** **** -- it is made as [perform / more effective smoothing] by things.

[0068]moreover -- dividing the inputted image data S40 into the three primary colors of RGB in a 3rd above-mentioned embodiment -- the separated image data S40G concerned, S40R, and S40B, although the case where it is alike, respectively, and received and image enhancement processing was performed was described, This invention performs image enhancement processing only to the luminance data of not only this but the inputted image data S40, and it may be made to reduce the whole operation amount.

[0069]As shown in drawing 12 which attaches and shows identical codes to a corresponding point with drawing 10, the image processing portion 81 of the video camera 80 inputs into the matrix circuit 82 of the image processing portion 81 the green image data S40G, the red image data S40R, and the blue image data S40B which are supplied from the color separation circuit 62. The matrix circuit 82 the green image data S40G, the red image data S40R, and the blue image data S40B, It changes into the color difference data S50C which subtracted the luminance data S50A concerned from the color difference data S50B and the blue image data S40B which subtracted the luminance data S50A concerned from the luminance data S50A and the red image data S40R, Among these, the luminance data S50A is sent out to the image processing circuit 3A and the dividers 83A and 83B, the color difference data S50B is sent out to the divider 83A, and the color difference data S50C is sent out to the divider 83B.

[0070]The image processing circuit 3A is constituted like the image processing circuit 3 shown in drawing 1, performs image enhancement processing to the luminance data S50A, and sends out the output brightness data S51A obtained as a result to the multipliers 84A and 84B and the camera signal processing circuit 64. The dividers 83A and 83B by doing division of the color difference data S50B and the S50C with the luminance data S50A, respectively, The normalization data S52A which normalized the color difference data S50B and S50C with the luminance data S50A, respectively, and S52B are generated, and these are sent out to the delay circuits 85A and 85B, respectively.

[0071]The delay circuits 85A and 85B carry out specified quantity delay of the normalization data S52A and the S52B, respectively, set these to the delay normalization data S53A and S53B, and send them out to the multipliers 84A and 84B. By carrying out the multiplication of the luminance data S51A to the delay normalization data S53A and S53B, respectively, the multipliers 84A and 84B generate the color difference data S54A and S54B, and send these out to the camera signal processing circuit 64.

[0072]In a further above-mentioned embodiment, although a case where this invention was applied to the video cameras 1, 50, and 60 was described, this invention can apply this invention not only to this but to other various image processing devices, for example like an electronic "still" camera, a printer, a display, and a computer widely. In this case, in a computer, when correcting picture contrast, a high-definition contrast

corrected image can be obtained, maintaining a dynamic range, When combining the pictures obtained under different lighting conditions, only a difference in each contrast component can be amended and natural image composing can be generated.

[0073]

[Effect of the Invention]By amplifying portions other than the edge concerned according to this invention, as mentioned above, while change of the pixel value had saved steep edge among inputted image data, Portions other than edge can be emphasized and displayed and the contrast and sharpness of the whole picture may be raised much more as compared with the former in this way.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing a 1st embodiment of the video camera by this invention.

[Drawing 2]It is a block diagram showing the composition of a nonlinear smoothing machine.

[Drawing 3]It is an approximate line figure with which explanation of operation of epsilon filter is presented.

[Drawing 4]It is a block diagram showing the composition of epsilon filter.

[Drawing 5]It is a block diagram showing the composition of a register sequence.

[Drawing 6]It is a block diagram showing the composition of a selector.

[Drawing 7]It is a block diagram showing the composition of the video camera of a 2nd embodiment.

[Drawing 8]It is an approximate line figure with which explanation of the input-output behavioral characteristics of a noise rejection filter is presented.

[Drawing 9]It is an approximate line figure with which explanation of a look-up table is presented.

[Drawing 10]It is a block diagram showing the composition of the video camera of a 3rd embodiment.

[Drawing 11]It is a block diagram showing the composition of the video camera of other embodiments.

[Drawing 12]It is a block diagram showing the composition of the video camera of other embodiments.

[Drawing 13]It is a figure showing the example of epsilon filter using the register 22.

[Drawing 14]It is a figure showing the number of the registers 22, and the relation of a frequency response.

[Drawing 15]It is a figure showing the coefficient of the filter corresponding to the

frequency response of drawing 14.

[Description of Notations]

60 [.... A nonlinear smoothing machine 12 / .... epsilon filter, 20 / .... A register sequence, 21 / .... A selector, 22 / .... A register, 23 / .... An amplifier, 40, 41 / .... An adding machine, 42, 84 / .... Multiplier.] .... A video camera, 2, 61 .... CCD, 3, 51, 72 .... An image processing circuit, 5